COMPARISON OF THE PERFORMANCE OF MACROECONOMIC FINANCE MODELS FOR FINANCIAL PLANNING (MFM-FP) AND ARIMA-COMMON SIZE IN FORECASTING ROE OF REAL ESTATE DEVELOPERS IN THE STOCK EXCHANGE OF THAILAND

Wachira Khuntaweetep[1,*] and Nattawoot Koowattanatianchai[2]

Abstract

An econometric model was created for strategic planning and ROE forecasting of real estate development companies in Thailand. The efficiency of the MFM-FP model was compared against an ARIMA-Common Size time series model by creating a simultaneous equation model using 2TSL, for analysis and forecasting. Assumptions on the proportion of the financial statement structure in each quarter were tested for differences. If proportional structure is not different, it can be used for forecasting together with ARIMA. MAPE was also used to assess the accuracy of the forecast results. The built MFM-FP model consisted of 15 identity equations, 22 behavioral equations, and 1 condition equation, with a total of 38 equations. For the ARIMA-Common Size model, the main assumption that the proportion of the structure of the financial statements in each quarter was not different, was accepted, with statistical significance at 0.05. Therefore, the data could be used for forecasting with the ARIMA model (3,1,2). For all variables assessed during the estimation period and the ex-post period, the MFM-FP model was more accurate than the ARIMA-Common Size model. It is therefore summarized that the MFM-FP model performed better than the ARIMA-Common Size model.

Keywords: Simultaneous Equation, ARIMA, ROE

INTRODUCTION

Forecasting is necessary for business firms to maintain good operating guidelines and to make management plans in various fields, in order to achieve the highest return on equity (ROE). Therefore, most businesses have created financial models to consider the impacts on management and the expected returns. For example, Warren et al. (1971) created an econometric model, using it to plan and monitor the effects of external variables that affect changes in sales, management ratios, and price per return. Another example is the case study of Artikis and Artikis (1999) which used econometric models to solve business cost problems.

Thus, forecasting models should be carefully chosen as each model has different forecasting performance; that is, each model type gives different predictive errors. A particular model will be effective if its forecasted values are close to actual values, as this produces low predictive errors.

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[1] * Wachira Khuntaweetep is currently working as a lecturer in the School of Economics, University of the Thai Chamber of Commerce (UTCC). He is a Ph.D. Candidate in the Business Administration Program, Kasetsart University. He obtained a master's degree in Economics from Kasetsart University. Email: wsong12@gmail.com

[2] Nattawoot Koowattanatianchai is an Assistant Professor of Finance in the Department of Finance at Kasetsart Business School. He has a Doctorate degree (DBA) in Finance from Southern Cross University and has earned the Chartered Financial Analyst (CFA) designation from the CFA Institute. He is currently a Director of the Master of Finance Program at Kasetsart Business School. His current research mainly focuses on asset replacement policies, financial services, and capital market studies.

For this reason, business firms must try to find a proper way to develop effective forecasting models. Popular model types used today are time series forecasting and regression equation forecasting. Time series forecasting ignores external factors while regression equation forecasting focuses on the identification of appropriate independent variables that directly affect the dependent variable. As a result, their forecasted results might be better or worse than expected. However, both methods are often used as the prototypes for developing a forecasted model that enables executives to plan and create strategies to generate a ROE that is consistent with the business' goals.

In this study, ARIMA was used as the time series model as it has a method and conditions close to the simultaneous model. The main condition is that the data must be stationary, i.e. time series data that have the same mean and variance over the course of the study period. Additionally, the ARIMA model is a popular model for forecasting trends, which has been used in other studies such as that of Siami Namini and Siami Namin (2018). The ARIMA model is more prominent than other time series forecasting, such as the Autoregressive model (AR), univariate Moving Average (MA), and Simple Exponential Smoothing (SES), as it provides more accurate forecasting performance. In addition, Mondal et al. (2014) stated that the ARIMA model is simple and widely accepted. Therefore, in this study, the ARIMA model was the representative of time series forecasting used to compare with a simultaneous equation model.

The forecasting performance of the two models newly developed for this study was compared. These models were the simultaneous equation model, entitled "the Macroeconomic Finance Model for Financial Planning (MFM-FP)", and a time series model, specifically the ARIMA model, used together with common size analysis named "ARIMA-Common Size". A performance comparison between the two models was carried out in the Thai real estate sector. A similar study was conducted by Schmid (1979), who compared the ARIMA model with a simultaneous equation model in the United States retail sector, finding that the former model was more effective. Our study follows Schmid's (1979) methodology closely. The study also aims to illustrate that the model can be used for business planning and to prevent financial risks that may arise in the event of a shifting business environment, either internally and externally. This study is presented as follows. Section 2 explores the concept of building economic models, discusses model comparisons, and postulates the study hypotheses. Section 3 explains the methods used. Section 4 presents the results and Section 5 offers conclusions.

Concepts of Model Development, Performance Comparison, and Hypothesis of the Study

Concepts of Model Development

Discussions of the concepts used to develop the forecasting model are divided into two parts: concepts for the MFM-FP model, and concepts for the ARIMA-Common Size model.

Concepts for Developing the MFM-FP Model

The MFM-FP model is based on economic, financial, and statistical concepts. Klein (1947) created a Simultaneous Equation Model for economic policy analysis. Friedman (1968) created the Expectation-augmented Phillips curve to describe the inflation and unemployment that occurred during the period, while Lucas (1976) added the prediction of stationarity. Hundson and Dymiotou-Jensen (1989) described the structure of delay in response to reality, and Lucas and Sargent (1981) built a model describing different economic environments. Later, Hall (1995) stated that econometric models show promise in understanding behaviors that occur in the economic system.

The Simultaneous Equation Model can be applied in various forecasting fields as well as in finance. Warren and Shelton (1971) developed the Simultaneous Equation Model for use in four sectors of financial planning, while Schendel and Patton (1978) built a model for financial strategy planning. Quantitative modelling is a valuable tool to help executives achieve company goals under a changing environment. Francis and Rowell (1978) created the FR Model for use in financial statement forecasting. Their FR Model consisted of 10 sectors with 36 equations representing Industry Sales, Company Sales and Production, Fixed Capital Stock Requirements, Pricing, Production Cost, Income, New Financing Required, Risk, Costs of Financing, and Common Stock Valuation. The equations created contained most of the variables from the financial statements as identity equations. Artikis and Artikis (1999) created a model consisting of 5 sectors and 29 equations representing Sales and Operating Income, Assets Required, Funds Needed to Provide the Assets per Share, Data, and Profitability. The model was created in response to financial life cycle forecasts that enabled strategic planning. Company capital cost was calculated using the weight estimated in the model and the model was also used to assess the situation and performance of the company.

In addition, Bergmann and Schultze (2018) analyzed the Simultaneous Equations Model's assessment results by comparing them with the error of two other models: the AR and the random walk. Moreover, regarding the information in anticipating the return that would occur, it was found that when using the data during times of economic volatility, the use of the SEM model was more accurate than either of the other models.

It can be seen in the literature that the simultaneous equation model used in the forecasting of financial statements is used for planning and strategy formulation because the model can effectively predict the effects of the external business environment. This study aims to illustrate the usefulness of using the developed MFM-FP model in the Thai business environment. This model consists of three interrelated equations, namely identity equations, behavioral equations, and condition equations. Variables in the model can be classified into exogenous variables and endogenous variables (Gujarati, 2003). It is also necessary to build a connection between these variables and other equations in the equation system. The forecasted model is created using the Two-Stage Least Square (2SLS) estimation method. Variables under the 2SLS method must be non-stochastic, meaning that they are not biased or inconsistent. The format of the Simultaneous Equations is presented as follows:

Simultaneous Equation Pattern

$$By_i + \Gamma x_i = u_i \tag{1}$$

$$y_i = \begin{bmatrix} y_{1i} \\ y_{2i} \\ \vdots \\ y_{Gi} \end{bmatrix} \quad x_i = \begin{bmatrix} x_{1i} \\ x_{2i} \\ \vdots \\ x_{ki} \end{bmatrix} \quad u_i = \begin{bmatrix} u_{1i} \\ u_{2i} \\ \vdots \\ u_{Gi} \end{bmatrix}$$

$$B = \begin{bmatrix} \beta_{11} & \beta_{12} & \cdots & \beta_{1G} \\ \beta_{21} & \beta_{22} & \cdots & \beta_{2G} \\ \cdots & \cdots & \cdots & \cdots \\ \beta_{G1} & \beta_{G2} & \cdots & \beta_{GG} \end{bmatrix}$$

$$\Gamma = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \cdots & \gamma_{1k} \\ \gamma_{21} & \gamma_{22} & \cdots & \gamma_{2k} \\ \cdots & \cdots & \cdots & \cdots \\ \gamma_{G1} & \gamma_{G2} & \cdots & \gamma_{Gk} \end{bmatrix}$$

where:

y_i = G x 1 vector of the endogenous variables

x_i = K x 1 vector of the predetermined variables

u_i = G x 1 vector of the disturbance terms

B = G x G matrix of the endogenous variable coefficients

Γ = G x K matrix of the predetermined variable coefficients

In Equation 1, the row vector of the erroneous term U is assumed as follows:

The mean is equal to 0. $E(u_i) = 0$.

The variance and covariance are positive. $E(u_i u_j') = \Sigma$ where Σ is a G x G matrix of variances and covariances, u_i has no sample cross-correlation. $E(u_i u_j') = 0$, where $i, j = 1,2, \ldots\ldots N$ and $i \neq j$.

In addition, to performing the 2SLS estimation of an equation, an instrument variable is required because, in OLS estimation, independent variables can correlate with error variables. The instrument variable is not correlated with the error variables but is correlated with the independent variable by setting the instrument variable to be z_i, as shown in Equation 2:

$$\beta^* = \frac{\sum y_i z_i}{\sum x_i^* z_i} \qquad (2)$$

where β^*= Instrumental Variable Estimator

From the above concept in Simultaneous Equation modelling, the Macroeconomic Finance Model for Financial Planning (MFM-FP) was created for ROE forecasting. The MFM-FP consists of seven sections as follows: 1) Economic Demand, 2) Supply or production sector of the economy, 3) Fiscal Economic, 4) Financial Economic, 5) Income Statement, 6) Balance Sheet and 7) Return on Equity.

Concepts for Developing the ARIMA-Common Size Model

The ARIMA model estimation was developed by Box and Jenkins (1970) as a time series model without considering external factors. In other words, the Box and Jenkins's (1970) ARIMA model employed a single variable from the past to produce future forecasts. Due to its simplicity, the ARIMA model has been used as a business tool in many areas. This model is however only appropriate in situations where the study variables show a long-term trend with cyclical and seasonal patterns (Mabert and Radcliffe, 1974). The ARIMA model is also used in finance. Lorek (1979) used the model to forecast net income, while Lorek and Willinger (1984, 2011) used the ARIMA model to forecast company cash flow statements. Lastly, Christian and Hee-Young (2013) used the ARIMA model to forecast prices in the stock market. Moreover, Paul et al. (2013) selected the ARIMA model for forecasting, finding the best model to be ARIMA (2,1,2)

Xia (2016) compared the ARIMA and VAR models in forecasting Tmall air-conditioning sales. Results showed that ARIMA provided better forecasting results than VAR models. Schmid (1979) conducted a comparative study between ARIMA and a structural model for retail sales forecasts and percentages of retail taxes important to the economy. Results indicated that the ARIMA model performed better. In addition, Tomić and Stjepanović (2017) produced capacity forecasts by using the ARIMA model in a case study of the industrial manufacturing sector of Croatia, and a more sophisticated sub-sector model of forecasting, which still had good results in forecasting.

Document reviews showed that the ARIMA model is used to forecast only a single variable. However, in this study, a detailed forecast of financial statements was required. Therefore, the common size analysis method was used to provide detailed forecasts of income statements and balance sheets. The ARIMA + Common Size model was used to build the ARIMA model for forecasting while the data were required to have stationary features. For data used at stationary level, the format of ARIMA (p,d,q) is either ARIMA (p,0,q) or ARMA (p,q), as shown in Equation 3.

$$Y_t = \delta_0 + \delta_1 Y_{t-1} + \delta_2 Y_{t-2} + \cdots + \delta_p Y_{t-p}$$
$$+ e_t - \varphi_1 e_{t-1} - \varphi_2 e_{t-2} - \cdots - \varphi_q e_{t-q} \qquad (3)$$

Or rewritten in the form $\delta(L)Y_t = \varphi(L)\varepsilon_t$ where $\delta(L)$ and $\varphi(L)$ are the polynomial degrees of AR and MA respectively. In cases where the data used for analysis are non-stationary, the difference must be represented as follows:

$$\delta(L)\Delta^d Y_t = \varphi(L)\varepsilon_t \qquad (4)$$

where:

$$\delta(L) = 1 - \sum_{j=1}^{p} \delta_j L^j$$

$$\varphi(L) = 1 - \sum_{j=1}^{q} \varphi_j L^j$$

$\Delta^d =$ the d-th differences operator

$\varepsilon_t =$ the White Noise Process

The Concept of Comparing Model Forecast Accuracy

The assessment of forecast accuracy evaluates the error of the forecast value and the actual value based on the Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE). Mihaela (2012) used RMSE and MAPE to compare the suitability of forecasting models, while Lawrence and Kelly (2013) assessed the accuracy of data uncertainty. In addition, Schmid (1979) compared the retail sales forecasts between econometric and time series models using precision analysis, together with RMSE and MAPE. In this study, model performance accuracy was assessed using RMSE and MAPE measurements. The model with the least difference in actual error is considered to be the most accurate and efficient. In addition, when comparing applications, RMSE was used to estimate the standard deviation of the forecast error, while the MAPE model produced the percentage of absolute error. This is often used to measure accuracy which needs to be compared in percentages (Akkaranuchat, et al., 2019). Therefore, the measure of model accuracy in this study was given mainly by the MAPE measurement.

Study Hypotheses

Financial structure testing hypothesis

This study combined the ARIMA Model and Common Size Analysis to forecast financial statement variables for executives to use in financial planning. Common Size Analysis involves vertical proportions of financial statements. Singh and Schmidgall (2013) analyzed the financial status of varied size hotel businesses in the United States. Part of their analysis was based on Common Size Analysis, which can also be used to forecast financial statements if the proportions for each quarter or year are not different. Thus, financial statements that can be used in forecasting with ARIMA must have the same vertical proportions. Two hypotheses were tested as follows:

H_0 : The proportion of the financial statements in each quarter is not different.

H_1 : The proportion of the financial statements in each quarter is different.

Assumptions for Evaluation of Forecast Performance from MFM-FP and ARIMA Models

To test the hypothesis of evaluating the forecast performance of the MFM-FP model with ARIMA, this study used the ROE MAPE efficacy evaluation results, obtained from the MFM-FP and ARIMA models to test the percentage mean error (MAPE) of the ROE generated by the models to determine whether they were different. In other words, if they were different, it would show that the forecasting performance of the two models, MFM-FP and ARIMA, was different. The hypothesis of the test was as follows.

H_0: The percentage mean error (MAPE) of ROE in the MFM-FP and ARIMA models was not different.

H_1: The percentage mean error (MAPE) of ROE in the MFM-FP and ARIMA models was different.

METHODS

This study used secondary data from economic and financial statements of 37 companies in real estate development that traded on the Stock Exchange of Thailand before 2006. Quarterly data were studied, starting from the first quarter of 2006 to the first quarter of 2019. A total of 53 quarters were factored into the study as described below.

Testing Hypotheses

Testing the Hypothesis of Differences in Financial Structure

The differences in the structure of the financial statements comprising income statements and balance sheets for each company in the real estate development business listed on the stock market were studied by vertically analysing the financial statements (Common size) and testing the hypotheses regarding the differences between the financial structures using a χ^2 test.

The study of changes in the structure of the financial statements was used as the basis for forecasting the future structure of financial statements in the ARIMA model based on changes in sales. If the proportion of the structure of financial statements is not different from the original, this shows that the proportion of sales cost, gross profit, current assets per total assets, and current liabilities per total liabilities, is similar to or in the same proportion as the original. Therefore, if forecasting future sales is achievable, it is possible to use the cost-to-sales ratio and gross profit per sale to forecast the value of the cost and gross profit in the same proportion.

Testing the Hypothesis of the Differences in Model Performance

In the study of differences in the predictive performance of the MFM-FP and ARIMA models, where the ROE MAPE was measured, it may be unclear whether the differences were true. Therefore, the hypothesis of difference in percentage mean error (MAPE) of ROE was tested using a paired sample t-test to determine whether or not it was different.

Unit Root Test

Stationary data of each variable were tested using an Augmented Dickey-Fuller Test (ADF) as the time series data varied and differed from the original according to the increasing timeframe. Therefore, for the estimation to be accurate, the data must be stabilised by testing the first difference or higher until the data became stable as follows:

Testing at Each Level

$$\Delta X_t = \alpha_0 + \alpha_1 t + \beta X_{t-1} + \sum_{j=1}^{m} \lambda_j \Delta X_{t-j} + \mu_t \tag{6}$$

Testing at the First Difference Level

$$\Delta(\Delta X_t) = \alpha_0 + \alpha_1 t + \beta \Delta X_{t-1} + \sum_{j=1}^{m} \lambda_j \Delta\left(\Delta X_{t-j}\right) + \mu_t \tag{7}$$

Where X_t is the study variable, t is the time trend, β is the coefficient of lag, μ_t is the error term when Δ is the change, and j=1,…m is the number of progressively increasing delays. In this equation, each hypothesis was tested as follows:

$$H_0: \beta = 0$$
$$H_1: \beta \neq 0$$

To accept the main hypothesis or the secondary hypothesis, a stationary analysis was performed at the first difference.

Creating the Two Forecasting Models: Autoregressive integrated moving average (ARIMA) + Common size Analysis Model and MFM-FP Model

Accuracy Assessment and Forecasting Results

As mentioned earlier, forecast accuracy is measured by the divergence between the actual data and the predicted values given by the forecasting model. This divergence can be indicated by RMSE and MAPE. The accuracy was assessed in two periods: the estimation period (Quarter 1, 2006-Quarter 1, 2016) and the ex-post forecasting period (Quarter 2, 2016-Quarter 1, 2018). Financial statement variables that were assessed included Total Revenue (TR), Total Cost (TC), Earnings Before Interest and Taxes (EBIT), Net Income (NI), Total Assets (AT), Total Liabilities (LT), ROA, and ROE.

Figure 1 shows how the prediction of ROE is computed during both the ex-post forecasting period and ex-ante forecasting period.

Comparison of Forecasting Model Efficacy

MAPE was used to measure the efficacy of both forecasting models. If a particular model gives a lower MAPE, it possesses better forecasting ability and is more efficient than the other model.

STUDY RESULTS

Results of comparing the efficiency of the Macroeconomic Finance Model for Financial Planning (MFM-FP) with ARIMA, together with the financial ratio for forecasting ROE of real estate developers in the Stock Exchange of Thailand, were as follows:

Results of the Financial Structure Ratio Hypothesis Test

Results of the hypothesis testing of 37 real estate companies revealed that the H_0 hypothesis test of income statements did not reject the main hypothesis. The proportional structure of the income statements for each quarter was not different for the 37

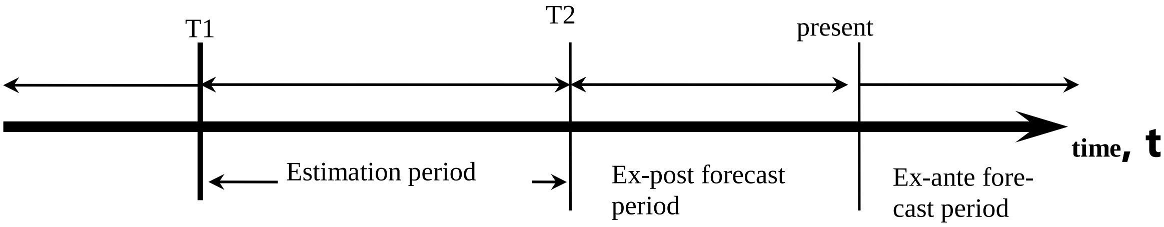

Figure 1 Forecasting Pattern

Table 1 Financial Statement Structure Test for the Real Estate Development Business

Company	Income Statement		Balance Sheet	
	X^2	P-value	X^2	P-value
A	43.289	0.666	31.082	0.972
AMATA	23.947	0.999	43.927	0.640
AP	38.363	0.839	26.503	0.995
BLAND	24.105	0.998	42.575	0.694
CGD	19.846	0.999	56.241	0.194
CI	28.737	0.988	23.974	0.999
CPN	34.859	0.922	19.038	0.999
ESTAR	31.838	0.965	21.765	0.999
EVER	23.913	0.999	16.795	0.999
GLAND	35.464	0.910	27.415	0.993
GOLD	28.770	0.987	33.324	0.947
KWG	20.652	0.999	18.322	0.999
LALIN	40.976	0.754	86.708	0.001
LH	23.598	0.999	17.881	0.999
LPN	36.242	0.893	19.422	0.999
MK	39.872	0.792	25.706	0.997
NCH	40.159	0.782	29.491	0.984
NNCL	35.956	0.900	25.065	0.997
NOBLE	39.348	0.809	26.528	0.995
NUSA	32.568	0.957	41.694	0.728
PF	32.401	0.959	22.675	0.999
PRECHA	28.392	0.989	18.115	0.999
PRIN	39.093	0.755	24.869	0.994
PRINC	15.667	0.925	18.866	0.999
QH	27.818	0.991	26.908	0.994
RML	32.605	0.956	21.070	0.999
ROJNA	17.020	0.999	25.537	0.997
SAMCO	43.934	0.640	18.880	0.999
SC	30.146	0.980	17.084	0.999
SF	31.276	0.971	38.919	0.822
SIRI	22.611	0.999	26.283	0.995
SPALI	23.939	0.999	20.229	0.999
TFD	40.413	0.773	32.727	0.955
TCON	31.482	0.969	43.197	0.670
U	7.408	0.984	49.513	0.413
UV	22.620	0.999	49.673	0.406
WIN	24.912	0.998	41.383	0.739

companies, while the balance sheet hypothesis H_0 test did not reject the main assumptions for 36 companies. Thus, the proportion of the balance sheet structures in each quarter was not significantly different at the 0.05 level. Only in the case of one company, LALIN, the main hypothesis was rejected, and the alternative hypothesis was accepted. The balance sheet structure was different for each quarter, with statistical significance of 0.05. However, when combining the financial statements of all companies, the structural proportion of the income statement and the balance sheet for each quarter were not different, as shown in Table 1.

Modelling and Forecasting Results from ARIMA + Common Size Model and MFM-FP

ARIMA + Common Size Model

In the ARIMA model, the stationary data were assessed using the ADF test method. Data showed that the TR variable was not stable at the zero level or I(0), but when performing the first difference or I(1), the TR data were stable, with statistical significance of 0.05. In addition, to find suitable values for p and q for the ARIMA model, the criteria to choose from was the lowest AIC and the lowest BIC. The lag test indicated that the optimal p-value was 3 and the optimal q-value was 2, while the lag of the error variable was 2 using ARIMA (3,1,2).

1) Optimal ARIMA Model

The suitable ARIMA model for forecasting was determined to be ARIMA (3,1,2) as follows:

$$dlog(TR) = 0.021 - 0.905 dlog(TR_{t-1})$$
$$-0.337 dlog(TR_{t-2}) - 0.432 dlog(TR_{t-3})$$
$$+0.001\varepsilon_{t-1} - 0.997\varepsilon_{t-2}$$

R^2	0.7482	**AIC**	-0.6085
$Adj.R^2$	0.70242	**BIC**	-0.3129
D.W.	2.05164		

When evaluating the ARIMA model (3,1,2), the Theil Inequality Coefficient (U) was approaching 0 at 0.00423, while the bias proportion was 0.00887, the variance proportion was 0.18054 and the covariance proportion was 0.81059, demonstrating a good level of forecasting ability (Figure 2).

Theil Inequality Coefficient	0.00423	Variance Proportion	0.18054
Bias Proportion	0.00887	Covariance Proportion	0.81059

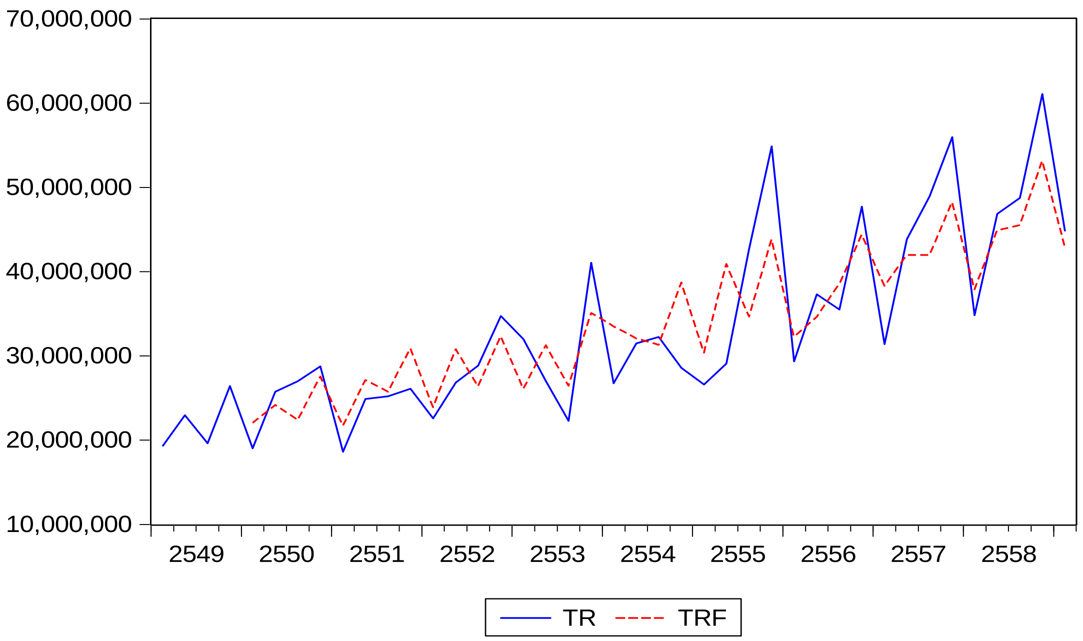

Figure 2 Estimation Results from the ARIMA Model (3,1,2) for the Real Estate Development Business

2) Forecast Accuracy of ARIMA + Common Size Model

The ARIMA (3,1,2) model was used to forecast real estate revenue. The accuracy of forecast results of the model for revenue during the estimation period revealed that RMSE was at 5,339.10 million baht, while MAPE was 12.23%. During the ex-post forecast period, the RMSE was 6,255.14 million baht and MAPE was 10.68%, as shown in Table 2.

Revenue forecast results using the Common Size model with a fixed financial statement structure during the estimation period showed the MAPE of TR, TC, EBIT, NI and ROE to be 12.23%, while the MAPE values of AT and LT were 6.23 and 11.81%, respectively, and the ROA was 5.84%. When considering the ex-post forecast period, RMSE, TR, TC, EBIT, NI and ROE were 10.68%, while the MAPE of AT, LT and ROA were 5.14%, 9.85 and 5.41%, respectively, as shown in Table 2.

3) ROE Forecast Results from ARIMA + Common Size Model

Results of the ARIMA (3,1,2) + Common size model in forecasting sales and ROE during the ex-post and ex-ante periods are shown in Table 3.

Table 2 Model Efficiency of the Real Estate Development Business Forecasting Using ARIMA (3,1,2) + Common Size Analysis Model.

List	Estimation Period (2006Q1-2016Q1)		Ex-Post (2016Q2-2018Q1)	
	RMSE	MAPE	RMSE	MAPE
TR	5,339.10	12.23	6,255.14	10.68
TC	3,844.91	12.23	4,476.93	10.68
EBIT	1,545.16	12.23	1,799.07	10.68
NI	1,187.31	12.23	1,379.52	10.68
AT	32,842.43	6.23	42,298.31	5.14
LT	32,842.43	11.81	42,298.31	9.85
ROA	0.15	5.84	0.09	5.41
ROE	0.60	12.23	0.38	10.68

Table 3 Sales and ROE Forecast Results From ARIMA (3,1,2) + Common Size Model.

Period	Quarter	Actual Sales		Forecast Sales	
		Sales (Million Baht)	ROE (%)	Sales (Million Baht)	ROE (%)
Ex post	Quarter 2, 2016	53,344.08	4.20	52,037.78	4.09
	Quarter 3, 2016	40,700.32	2.21	43,289.12	2.35
	Quarter 4, 2016	51,761.70	2.87	58,079.21	3.22
	Quarter 1, 2017	42,442.47	2.48	46,526.13	2.72
	Quarter 2, 2017	54,051.20	4.18	62,544.23	4.84
	Quarter 3, 2017	56,896.10	2.82	48,348.81	2.40
	Quarter 4, 2017	57,492.72	3.25	66,850.51	3.78
	Quarter 1, 2018	50,015.17	2.74	46,108.48	2.53
Ex ante	Quarter 2, 2018			67,872.68	3.94
	Quarter 3, 2018			51,136.33	2.55
	Quarter 4, 2018			74,369.09	3.69
	Quarter 1, 2019			54,924.95	2.77

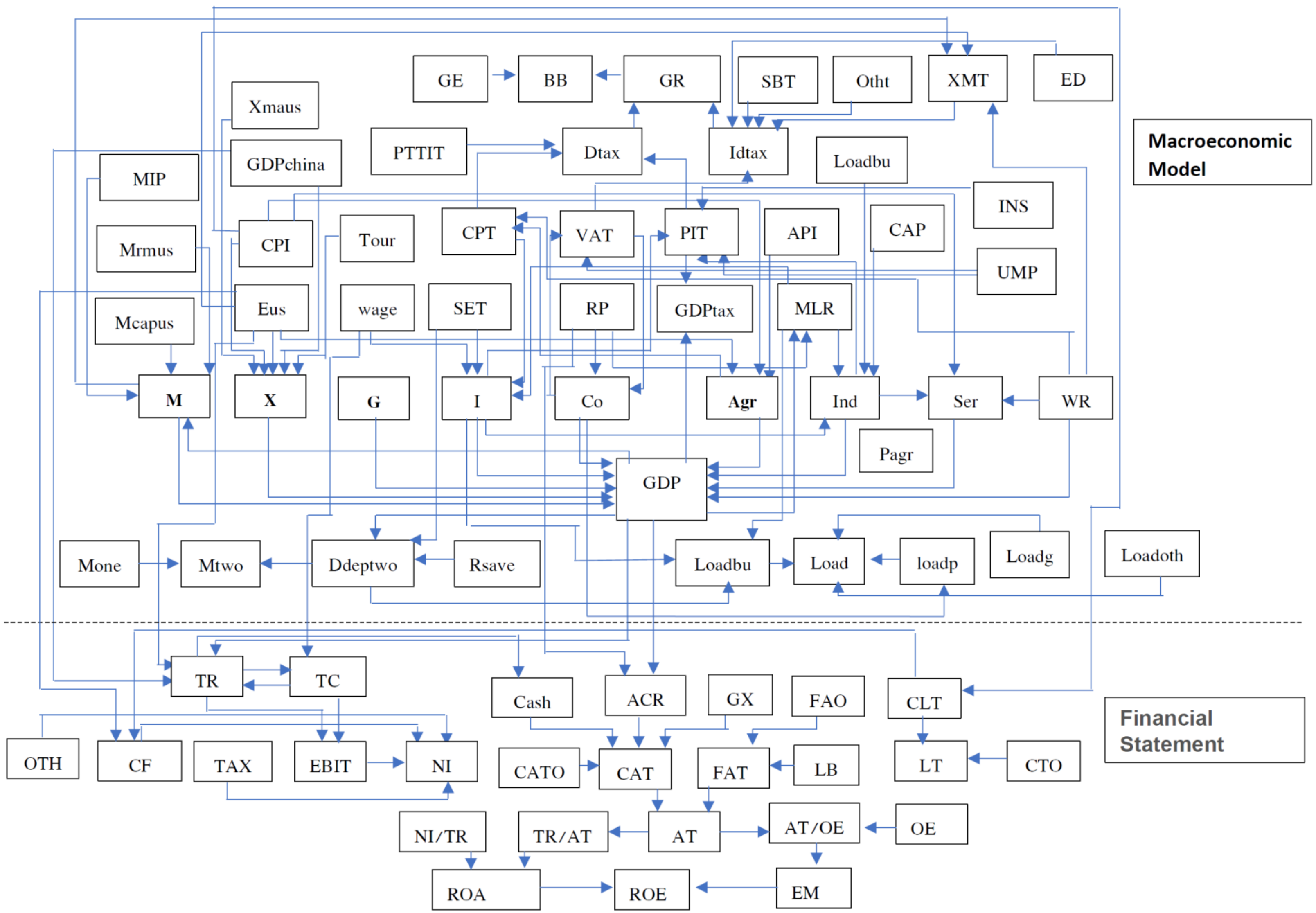

Figure 3 Structure of the Macro-Economic Finance Model.

MFM-FP Modelling

1) Integrated Macroeconomic Finance Model for Improving the Level of Financial Forecasting Ability and Financial Planning (MFM-FP)

The Integrated Macroeconomic Finance Model for Improving the Level of Financial Forecasting Ability and Financial Planning (MFM-FP) has three types of equations with 15 identity equations, 22 behavioral equations and one conditional equation, totalling 39 equations divided into seven blocks

2) Forecast Accuracy of MFM-FP Model for the Real Estate Development Business

The MFM-FP model used to forecast the financial statements of the real estate business revealed the revenue forecast accuracy during the estimation period with MAPE variables of 1.90% to 4.75% (Table 4). During the ex-post forecast period, the financial statement variables had RMSE values between 2.80% and 6.11%, as shown in Table 6.

3) ROE Forecast Results from ARIMA + Common Size Model

Based on the MFM-FP Model, the revenue forecast results and ROE during the ex-ante and ex-post periods are shown in Table 5.

Table 4 Efficiency of the MFM-FP Model for the Real Estate Development Business

List	Estimation Period (2550Q1-2559Q1)		Ex-Post (2559Q2-2561Q1)	
	RMSE	MAPE	RMSE	MAPE
TR	1,160.90	2.93	1,477.81	2.80
TC	914.33	3.22	1,302.68	3.01
EBIT	297.45	3.30	544.56	3.37
NI	204.00	3.28	386.05	3.31
AT	15,891.20	3.23	27,795.46	3.25
LT	5,213.54	1.90	10,620.40	2.20
ROA	0.08	4.75	0.10	6.11
ROE	0.11	3.28	0.11	3.31

Table 5 Sales and ROE Forecast Results from ARIMA (3,1,2) + Common Size Model.

Period	Quarter	Actual Sales		Forecast Sales	
		Sales (Million Baht)	ROE (%)	Sales (Million Baht)	ROE (%)
Ex post	Quarter 2, 2016	53,344.08	4.20	51,339.08	4.12
	Quarter 3, 2016	40,700.32	2.21	42,307.96	2.13
	Quarter 4, 2016	51,761.70	2.87	52,898.45	3.02
	Quarter 1, 2017	42,442.47	2.48	41,464.45	2.38
	Quarter 2, 2017	54,051.20	4.18	54,620.51	4.08
	Quarter 3, 2017	56,896.10	2.82	58,426.41	2.83
	Quarter 4, 2017	57,492.72	3.25	59,249.23	3.39
	Quarter 1, 2018	50,015.17	2.74	48,321.99	2.62
Ex ante	Quarter 2, 2018			50,561.10	2.94
	Quarter 3, 2018			51,246.41	2.56
	Quarter 4, 2018			64,573.82	3.37
	Quarter 1, 2019			50,544.03	2.83

Performance Comparison

The forecasting results during the estimation and the ex-ante forecasting periods indicate that the MFM-PF model is more accurate than the ARIMA-Common Size model. This implies that the MFM-PF model has the ability to produce forecasted values that are closer to the actual values than those given by the ARIMA-Common Size model. Table 6 shows the forecasting results.

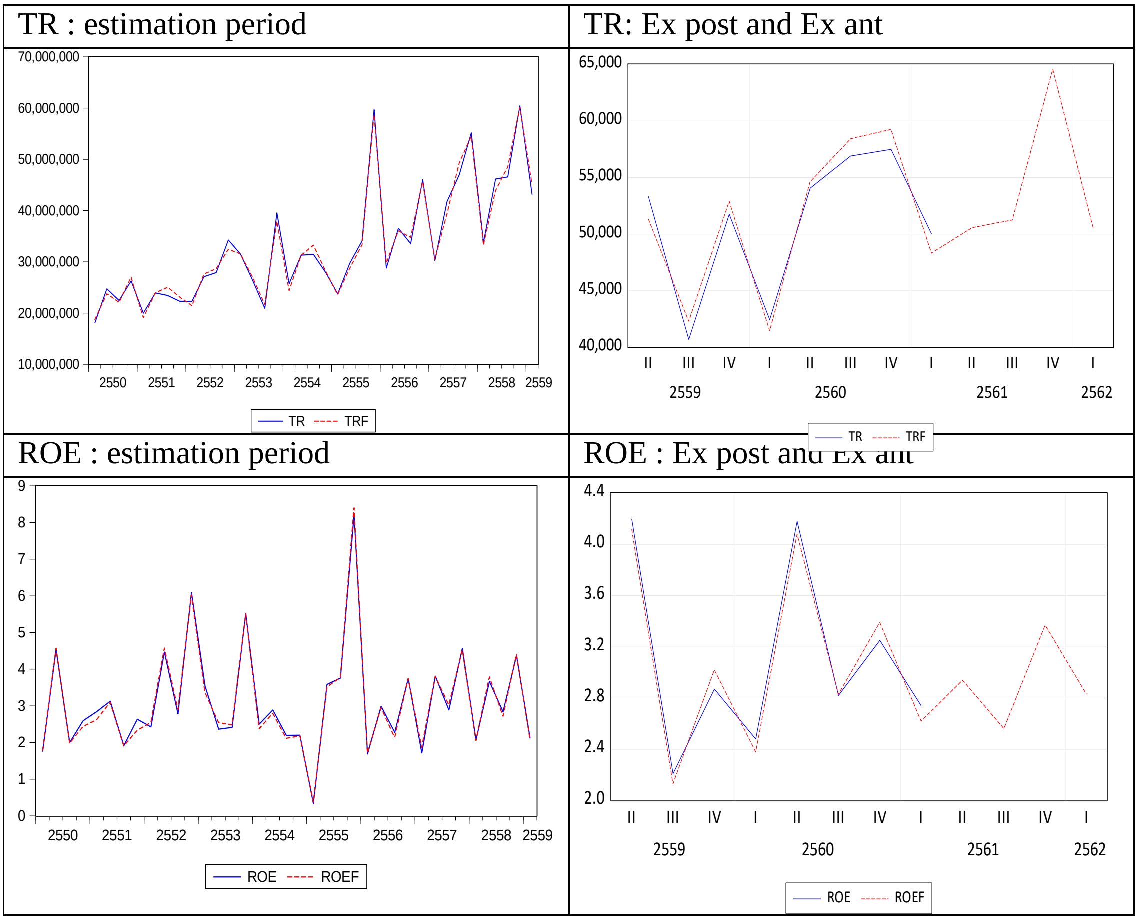

Figure 4 Sales and ROE Forecast Results of the Real Estate Development Business Using MFM-FP.

Table 6 Efficiency Comparison Between the MFM-PF Model and the ARIMA-Common Size Model.

List	MAPE During Estimation Period (2550 Q1-2559 Q1)		MAPE During Ex-Post (2559 Q2-2561 Q1)	
	ARIMA	MFM-FP	ARIMA	MFM-FP
TR	12.23	2.93	10.68	2.80
TC	12.23	3.22	10.68	3.01
EBIT	12.23	3.30	10.68	3.37
NI	12.23	3.28	10.68	3.31
AT	6.23	3.23	5.14	3.25
LT	11.81	1.90	9.85	2.20
ROA	5.84	4.75	5.41	6.11
ROE	12.23	3.28	10.68	3.31

In addition, when evaluating the testing of the hypothesis of the forecast performance from the MFM-FP model with ARIMA, using the ROE MAPE performance evaluation results obtained from the model, it was found that the test results rejected the main hypothesis. However, the secondary hypothesis was accepted, i.e. the mean percentage error (MAPE) of the ROE in the MFM-FP and ARIMA models differed statistically at 0.05 (Table 7).

CONCLUSION AND SUGGESTIONS

This study compares the efficiency of the MFM-FP model, which was developed using the concepts of the simultaneous equation model, to that of the ARIMA-Common Size model, which is based on a time series model. The aim was to create a model that is more appropriate for forecasting the ROE. An accurate forecasting model can help investors to make good investment decisions. It is also a tool to assist firm executives in making correct decisions when forming strategic plans. Moreover, it can be beneficial for the risk management department of a company when deciding how to deal with uncontrollable factors that might adversely affect the firm's operations and the achievement of business goals. In addition, this study attempts to ascertain the differences between using the simultaneous equation model with external factors and the time series model without external factors for forecasting. The goal is to see which model is more effective in forecasting and whether the forecasting results of this study corroborate those offered by previous studies. Financial statements were also subjected to testing in order to discover whether their proportional structure remains stationary over time.

The results show that most listed companies on the SET exhibit a stable proportional structure in their financial statements over time, which is consistent with the concepts necessary for common size analysis. Ergo, the ARIMA-Common Size model can be used to accurately produce a forecasted ROE based on estimated sales in the future.

In contrast, the forecasted ROE produced by the MFM-PF model does not depend only on estimated sales in the future alone, but also external factors that affect the financial statements. Forecasting results from the MFM-PF model reveal that there is a difference in the accuracy of each variable in the financial statements.

Performance comparison between the two models indicates that the MFM-PF model is more accurate than the ARIMA-Common Size model for forecasting. In particular, the MAPE of the MFM-PF model is lower than that of the ARIMA-Common Size model. The MFM-PF model was found to be more accurate during both the estimation period and the ex-post forecasting period than the ARIMA-Common Size model.

The MFM-FP model was also more effective in forecasting ROE and other variables in financial statements than the ARIMA-Common size method. Financial statements are affected by changes due to external factors and also depend on company policy and management approaches to prevent risks or fluctuations. The results of this comparative study differed from Schmid (1979), who found the ARIMA model to be more efficient than the simultaneous equations model. The financial data of the real estate business in Thailand is found to be dependent on external factors rather than historical attributes. The MFM-FP, as the simultaneous equations model, is similar to the models used by Warren, Schmidt and Shelton (1971), Schendel and Patton (1978), Francis and Rowell (1978), and Artikis and Artikis (1999), but differs in the nature of its internal and external variables, including the

Table 7 Results of the Mean Percentage Error Hypothesis Test (MAPE) of the ROE in the MFM-FP Model Compared With ARIMA.

Types of Business	t-test	p-value
Real estate development	-15.525	0.001

number of sections and the number of equations. Both models use simultaneous equation modelling as a tool for planning financial strategies. The simultaneous equations model extracts better details than the time series model. However, the simultaneous equations model has limitations in forecasting or predicting behavioral equations in which parameters of the dependent variables are estimated only during the estimation period. Consequently, its forecasted results may be highly inaccurate if the dependent variables in the behavior equations change significantly from crises such as shutdown of the country, or natural disasters. Thus, the simultaneous equations model must be constantly improved, especially with regard to its behavioral equations.

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Appendix A Variables in Macro-Economic Finance Model.

Variable	Definition	Variable	Definition
GDP	Gross Domestic Product	SBT	Specific Business Tax
CO	Consumption	XMT	Import-Export Tax
G	Government Expenditure	ump	Unemployment (person)
I	Investments	ins	Life Insurance
X	Exports	Mtwo	Broad Money
M	Imports	Mone	Narrow Money
rp	Repurchase Rate	ddeptwo	Quasi-Money
vat	Value Added Tax	Rsave	Interest Rate on Saving Accounts
cpt	Corporate Income Tax	load	Total Loan
MLR	Minimum Loan Rate	loadg	Government Loan
set	Stock Exchange of Thailand	loadoth	Other Loan
wage	Average Wage	loadp	Personal Loan
CPI	Consumer Price Index	NI	Net Income
Eus	Exchange Rate of Baht Per US Dollar	CF	Financial Cost
Xmaus	Basic Product Export Value	OTH	Others
GDPchina	Gross Domestic Product of China	EBIT	Earnings Before Interest and Taxes
Tour	Tourist	TAXC	Central Tax
Mcapus	Imported Capital Goods Value	TR	Total Revenue
Mrmus	Imported Raw Materials and Intermediate Goods Value	TC	Total Cost
MIP	Import Price Index	pagri	Agricultural Price Index
AGR	Agricultural Sector	LL	Long-Term Liabilities
api	Manufacturing Production Index	AT	Total Assets
Ind	Industrial Sector	CAT	Total Current Assets
cap	Production Capacity	FAT	Total Fixed Assets
loadbu	Business Loan	cash	Cash and Cash Equivalent
SER	Service Sector	ACR	Accounts Receivable
WR	Commercial Sector	GX	Inventories
GDPtax	Gross Domestic Product Taxes	CAO	Other Current Assets
pit	Personal Income Tax	LB	Land, Buildings and Equipment
BB	Fiscal Balance	FAO	Total Non-Current Assets
GR	Government Revenue	CLT	Total Current Liabilities
GE	Government Expenditure	LTO	Other
dtax	Direct Tax	LT	Total Liabilities
idtax	Indirect Tax	ROE	Return on Equity
pttit	Petrochemical Tax	ROA	Return on Assets
ED	Excise Duty	EM	Equity Multiplier
otht	Other Taxes	OE	Total Equity